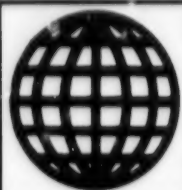


JPRS-UEE-89-004

24 MAY 1989



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JPRS Report

Science & Technology

***USSR: Electronics &
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USSR: Electronics and Electrical Engineering

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24 May 1989

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UDC 621.391

UDC 621.375.029.64

Phase Filtration Algorithm Involving Tikhonov Approximation and Its Execution on Microprocessor

18600019h Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 8 (manuscript received after completion
12 Aug 87) pp 83-88

Design of Low-Noise Single-Stage Microwave Transistor Amplifiers Taking Into Account Noise Figure

18600021c Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received after completion
14 Dec 87) pp 15-19

[Article by A. I. Tolstoy]

[Article by V. N. Kharisov, Yu. N. Kirilenko, and A. I. Fedorov]

[Abstract] Phase filtration algorithms which involve a Tikhonov approximation of the a posteriori probability density are considered, the algorithm of integral Tikhonov approximation known to be the most accurate. It is analyzed in discrete time, for execution on a microprocessor, rather in continuous time and the Kulback-Leibler criterion is used for determination of the Tikhonov distribution parameters. It is programmed for execution on a series 1804 general-purpose microprocessor with a read-only memory and a resolver, in four steps per iteration. Its performance in reception of a signal with a "Wiener" phase is evaluated and compared with that of the Gaussian approximation algorithm, the dispersion of filtration error as a function of time having been calculated by computer simulation of the process. Figures 3; tables 1; references 7: 3 Russian, 4 Western (2 in Russian translation).

[Abstract] Design of low-noise single-stage microwave transistor amplifiers is considered, with the noise figure as design criterion. The latter combines noise factor N nominal gain G into the ratio $(N-1)(1/G)$, nominal gain corresponding to conjugate matching of the transistor output. Both amplifier performance parameters as well as the other two, input and output VSWR, are determined by S -matrix and τ -matrix parameters of the transistor together with the two reflection coefficients at the transistor input and output respectively. The design procedure involves calculating the input reflection coefficient which will ensure the required amplifier noise figure. The ranges of both, established with the aid of the circle diagram include the minimum noise figure and the corresponding nominal gain, the limiting noise figure for potentially unstable transistors, the maximum noise figure (infinite for stable transistors), and the noise figure corresponding to minimum input VSWR. The design procedures for minimum noise figure and for noise figure corresponding to minimum input VSWR, also that for some specified noise figure and nominal gain, are outlined and then demonstrated with numerical data on a low-noise microwave amplifier with a single AP325A2-transistor stage. Figures 2; references 7: 6 Russian, 1 Western.

Packet Transmission for Amateur Radio Communication

18600029a Moscow RADIO in Russian
No 8, Aug 88 pp 12-13

[Article by S. Bunin (UBSUN), Kiev]

[Abstract] Packet transmission of messages for amateur radio communication is explained, the author having learned about it on his "USSR-North Pole-Canada" ski touring expedition. Packet transmission is a computer-aided error-free mode of documentary radio communication, a computer being coupled to the short-wave or ultrashort-wave radio transceiver through a Terminal Node Controller. The latter, the key component of such a system, consists usually of a special-purpose microcomputer and a modem. Messages are transmitted digitally in packets which form a data frame and a tracking service frame, each with 01111110 "begin reception" and "end reception" flags and with a 112/560-bit address in ASCII code. A check sum is included for error detection during reception of a packet frame.

Loop Antenna for Radio Receivers

18600029b Moscow RADIO in Russian
No 8, Aug 88 pp 20-22

[Article by N. Khlyupin (RA4NAL), Kirov]

[Abstract] An outdoor antenna for short-wave radio receivers is proposed which will eliminate the need for an indoor booster antenna. It is a small loop antenna, 300 mm in diameter, designed for five frequency bands (3.5, 7, 14, 21, 28 MHz) with a sharp dip in its radiation pattern which contributes to interference suppression by 20 dB at 3.5 MHz and by 26 dB at 28 MHz. The circular loop is made of a 75-ohm 4/15 coaxial television cable, mounted on a frame consisting of two crossing arms, and coupled to the receiver through a matching symmetric differential amplifier on a pair of KP303 field-effect transistors which increases the signal-to-noise ratio. The receiver output amplifier on a GT311 bipolar transistor has a common-emitter connection with strong negative voltage feedback through an RC series circuit, which ensures a uniform gain over a wide frequency range as well as low input and output impedances. Figures 5; references 6: Russian.

Preselector with Quartz Filter

18600029c Moscow RADIO in Russian
No 8, Aug 88 pp 23-24

[Article by V. Ivanenko (RB51Z), Gorlovka (Donetsk Oblast)]

[Abstract] A preselector has been built for signal selection prior to amplification and frequency conversion, the purpose being to widen the dynamic range of the radio receiver. It includes a ZQ1 quartz filter with a center frequency of 55,492 kHz and two frequency conversions take place in the receiver with the same heterodyne oscillator involved in both, according to V. I. Yuzvinskiy's method, first step-up from signal frequency to filter frequency before selection and then step-down back to signal frequency after selection. The exact signal frequency is thus recovered, independently of the heterodyne frequency adjustable over the 25-5 MHz range. This relaxes the stability requirement for frequency synthesizer. A simple LC heterodyne oscillator with an up to 2 kHz frequency drift over a 10 min period not only suffices where a stable heterodyne frequency is required but also generates a spectrally pure heterodyning signal. In addition to the quartz filter, this preselector contains also an LC filter with a 0.15-30 MHz passband and a 75 ohms input impedance, two frequency converters, a balanced twin-bridge switching one on eight diodes and a plain balanced one on two transistors, and a differential amplifier on six transistors connected to the heterodyne oscillator and driving the two-bridge switch with a meander voltage. Two transformers feed alternately signal currents to the quartz filter. Both crosstalk and intermodulation interference are effectively suppressed throughout the 0.15-30 MHz operating frequency range. The author thanks A. Khromenkov (UB51GX) for assisting in the design of this preselector. Figures 1; references 3: Russian.

Programmable Classroom with MK-56 Microcalculators, Part 1

18600029d Moscow RADIO in Russian
No 8, Aug 88 pp 25-27

[Article by N. Semenov and V. Panarskiy, Moscow]

[Abstract] A programmable classroom with MK-56 microcalculators has been developed by the Department of electrical Multichannel communications at the Moscow Institute of Communications. The key element linking the teacher's programmable microcalculator with up to 25 students' programmable microcalculators is a device which reads in, records, and stores programs. It scans the dynamic data array with strobing pulses appropriately shaped and delayed by two respective circuits. It also includes a register, an address counter, a program

selector, a decoder, and a panel. The decoder consists of a 128-byte read-only memory and a counter with a trigger. All components are built on integrated-circuit microchips. Figures 4.

UDC 621.317.795.3

**Charge Storing Characteristics of Vidicons
Brightened by Laser Pulses**

*18600031a Leningrad IZVESTIYA VYSSHIKH
UCHEBNYKH ZAVEDENIY:*

PRIBOROSTROYENIYE in Russian

Vol 31 No 7, Jul 88 (manuscript received

13 Jul 87) pp 60-63

[Article by V. A. Nikolayenko and A. S. Semenov,
Ulyanovsk Polytechnic Institute]

[Abstract] Charge storage on the vidicon target surface during brightening by nanosecond laser pulses is analyzed and evaluated, taking into account the much longer millisecond time constant of the photoelectric effect. The analysis is based on the differential equation describing the surface-potential buildup kinetics in accordance with the model of a target having a charging capacitance and an illuminance-dependent charging resistance, the illuminance and thus also the resistance being functions of time because the luminous flux arriving from the laser is. The variation of the luminous flux in time is approximated with a normal distribution over a charging period, experimental data indicating that such an approximation is more accurate than a cosinusoidal distribution. A numerical solution has been obtained with both approximations by the fourth-order Runge-Kutta method using the single-step procedure, for various ratios of dark resistance to maximum resistance (10,000) and various lengths of exposure time (1, 2, 5 ns). Figures 2; references 8: 7 Russian, 1 Western (in Russian translation).

UDC 621.396.674.3

Interaction of Dipole Antennas Mounted on Elliptical Cylinder

18600019e Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 88 (manuscript received after completion
30 Nov 87) pp 65-70

[Article by V. A. Kvartsov, G. V. Kvartsova, and O. L. Ulasik]

[Abstract] Excitation of an elliptical cylinder by dipole antennas mounted on or near its lateral surface is treated as an external boundary-value problem, assuming a sinusoidal current distribution along each dipole. The problem is solved for a dipole mounted longitudinally, on or parallel to the major axis of an elliptical cross-section plane, and for a dipole mounted radially. The field components are for each dipole calculated by the Stratton-Chu method, whereupon both resistive and reactive components of the mutual impedance are calculated by the method of induced e.m.f.'s. The algorithms of numerical integration after series expansion of the Mathieu functions have been programmed for asymptotic solution of the dipole interaction problem. Figures 4; references 8: 6 Russian, 2 Western (1 in Russian translation).

UDC 621.396.677.494

Estimating Angular Width of Scan Sector for Phased Antenna Array

18600021d Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received 7 Sep 87) pp 56-57

[Article by G. A. Poluzhin and A. G. Shubov]

[Abstract] A formula for the angular width of the scan sector of a phased equidistant antenna array forming an arbitrary regular triangular grid is analyzed numerically,

for design estimates. This formula expresses the angle of the scan sector as an implicit \sin^{-1} -function of two dimensional ratios which define the array geometry, namely ratios of the operating wavelength to twice each of the two orthogonal projections of the distance between two neighboring array elements. The advantage of a regular triangular grid with a base angle within the 30-60 deg range over a regular hexagonal one is a redundancy of radiators. Figures 3; references 1: Russian.

UDC 681.7.068

Generalized Parameter Characterizing Field of Dielectric Cylinder

18600021e Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received after completion,
5 Oct 87) pp 62-65

[Article by A. A. Vorontsov and S. D. Mirovitskaya]

[Abstract] A generalized parameter is proposed for dielectric cylinders which ensures that the angular coordinates of the minima in the diffraction pattern depend on the cylinder diameter invariantly with respect to electrical characteristics and internal structure of such cylinders, this parameter thus allowing to exclude from consideration all cylinder characteristics which influence refraction of waves. Derivation of the generalized diameter-dependent angular coordinates is based on a rigorous mathematical analysis of the diffraction pattern, first considering the three central diffraction minima and then the successive lateral ones. Calculations for cylinders with diameters of 0.190-0.220 mm and a refractive index of 1.5818 in the field of parallel polarized 632.8 nm light have yielded a consistent universal relation describing the dependence of these diffraction pattern parameters on the parameters of dielectric cylinders relevant to geometrical optics. Figures 4; references 5: 4 Russian, 1 Western (in Russian translation).

UDC 621.396

Use of Recursive Filters with Tunable Memory for Processing Radar Measurements

18600021a Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received after completion
20 Jan 88) pp 3-7

[Article by M. G. Stepanov and A. V. Muravyev]

[Abstract] A recursive filter with a tunable limited memory is proposed for real-time processing of measurements made by an aircraft-tracking radar, in preference to a recursive filter with plain limited memory and to a fixed-gain Karman filter with a not precisely limited memory. A simple algorithm of linear filtration with flexible memory regulation is constructed by treatment of the problem as one involving discrete filtration of a random process and estimation of linear-regression parameters in accordance with the method of least squares. An evaluation of its performance in a radar mounted on one aircraft tracking another indicates that such a filter contributes to a much higher accuracy of radar measurements than do conventional filters. Figures 3; references 7: 5 Russian, 2 Western (1 in Russian translation).

UDC 621.391

Optimization of Navigation and Communication System Performance Under Conditions of Intentional Noise Jamming

18600021b Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received after completion
27 Nov 87) pp 7-10

[Article by V. I. Platonov, A. A. Matveyev, and O. V. Pimenova]

[Abstract] The performance of a navigation and communication system under conditions of intentional powerful jamming by a Gaussian noise is analyzed, considering specifically a data transmission system which operates with an ensemble of m wideband signals orthogonal at a point, with optimum noncoherent reception of individual wideband signals, with the Reed-Solomon external corrective code, and with pseudorandom adjustment of the operating frequency from pulse to pulse within a message. Maximization of its interference immunity under said conditions is considered, with maximum energy efficiency equivalent to minimum signal-to-noise

energy ration per information bit selected as the optimality criterion. Following a general analysis of the problem, the optimum parameters are calculated for a short-range shortwave navigation and communications system (460 km radius, lower end wave band 0.25 m) with a 50 W transmitter operating against a noise at a level 10 dB above that of fluctuation noise with a spectral power density of $5 \cdot 10^{-20}$ W/Hz in the receiver. These parameters include the code parameters n (length of code word) equal to $m-1$, k (number of information symbols per code word), and r (number of correctable errors) equal to $1/2(n-k)$, as well as the error probability per information bit, a function of the signal-to-noise energy ratio. These four parameters determine all the others, which include transmission rate, time length of code word, information content in code word, and computer speed required for execution of decoding algorithm. Figures 2; tables 1; references 4: Russian.

UDC 621.396.96

Functional Adaptive Microprocessor Processing of Signals in Airborne Subsystem of Radio Navigation System

18600021f Moscow *RADIOTEKHNIKA* in Russian
No 7, Jul 88 (manuscript received after completion
27 Oct 87) pp 78-83

[Article by A. K. Bernyukov]

[Abstract] Functional adaptive processing of signals, after their analog-to-digital conversion, by a microprocessor in the airborne receiver end of an angle measuring channel of prospective radio pulse-time aircraft navigation and microwave aircraft landing guidance systems or short-range radio navigation systems. Such processing is expediently subdivided into three stages, identification and classification of distributed clutter relative to the control safety level being followed by fixation of the signal (pulse) time and the off-beam clutter time by the method of nonparametric detection. In the third and last stage interaction of the signal and the on-beam interference is analyzed, for extraction of the resulting signal distortion and necessary correction to ensure accurate time fixation of signal pulse and interference pulse. Each stage is preceded by data restoration in the direct access memory. Selection of a micro-processor is based on a low discretization frequency for narrow-band signal and clutter and a narrow radiation pattern of radio beacons for aircraft navigation and landing guidance. Figures 5; references 13: 1 Russian, 2 Western.

UDC 62-83:621.313.2.045.001.5

Electromechanical Manipulator with External Magnetic Systems

18600030a Moscow *ELEKTRICHESTVO in Russian*
No 7, Jul 88 (manuscript received 23 Jun 87) pp 57-62

[Article by A. M. Litvinenko, candidate of technical sciences, Voronezh Polytechnic Institute]

[Abstract] The feasibility of designing not only the drives for directional degrees of freedom and grippers of an electromechanical manipulator such as in the industrial robots RPM-25, MP-1 "Puma," Elektronika NTsTM-30 but also the drives for its regional degrees of freedom with external magnetic systems as a further step in size and weight reduction is examined, a spherical magnet structure being considered on the basis of experience. Analysis of the manipulator structure and kinematics, including operation of electric drive motors with photoelectric commutator control using OR logic reveals that to every solid angle corresponding to a possible drive set position corresponds a solid angle which uniquely defines the working zone and that without auxiliary means the performance factor for such a manipulator not only will never exceed 50 percent, inasmuch as in the extreme case both angles are equal to 360 deg, but will often be lower owing to kinematic constraints. The design of an external magnetic structure, including an internal segment which closes the flux path, is treated as a problem of linear programming for length minimization under a set of constraints. The problem is solved analytically by the method of external energy fluxes and then numerically by the simplex method, a solution

having been obtained on a YeS-1022 computer for a linear model with empirically matched coefficients and for a nonlinear model with analytically determined coefficients. Figures 8; references 9: Russian.

UDC 531.854:531.74

Quasi-Optimum Algorithm of Signal Processing in Interference Goniometer

18600031b Leningrad *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian*
Vol 31 No 7, Jul 88 (manuscript received 12 Jun 87) pp 83-86

[Article by A. L. Andreyev and Yu. V. Kudryavtsev, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A quasi-optimum recursive algorithm of signal processing in an opto-electronic single-coordinate interference goniometer for rotation measurements is construction, such an instrument consisting of a Kester prism between a laser as light source, a mirror, and a multielement charge-coupled-device photodetector array feeding signals to a microcomputer. The algorithm is based on the functional dependence of the signal frequency and phase on the angular displacement of the monitored object, the signal amplitude and the width of the signal envelope as well as the location of its center also being involved in the measurements. The algorithm is constructed in accordance with Markov's theory of nonlinear filtration and it yields estimates of a four-dimensional state vector. Figures 3; references 5: 4 Russian, 1 Western (in Russian translation).

UDC 621.373.5

Locking of Gunn-Effect Microwave Oscillator
18600019b Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 8 (manuscript received after completion
10 Sep 87) pp 26-28

[Article by G. N. Dekin and A. F. Tereshchenko]

[Abstract] Locking of a Gunn oscillator to an external signal is analyzed on the basis of two concise equations for the rates of change of amplitude and phase respectively, in accordance with the theory of oscillations, assuming that the current-voltage characteristic of the diode is an approximately exponential one. The maximum amplitude of synchronous oscillations is determined, whereupon the conditions for stability are established. Calculations supported by experimental data reveal that the amplitude-frequency characteristic becomes more asymmetric with an increasing bandwidth as the d.c. bias voltage is decreased and the admittance of the high-frequency load is increased, the susceptance of the diode decreasing and the transient period becoming longer, the amplitude-frequency characteristic tends to become symmetric corresponding to limited space-charge accumulation. Figures 2; references 9: Russian.

UDC 621.372.4:621.375.4

Structural Synthesis of Corrective Two-Pole Networks for Low-Noise Microwave Transistor Amplifiers
18600019c Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 88 (manuscript received 21 Aug 87) pp 31-35

[Article by M. Yu. Pokrovskiy and L. I. Babak]

[Abstract] Design of a low-noise microwave transistor amplifier with two corrective two-pole networks is considered, their purpose being to flatten its amplitude-frequency characteristic, improve its stability, and ensure proper matching at both input and output sides. In order to synthesize the two networks, it is necessary to first determine the allowable range of their immitances at specified points within their operating frequency range on the basis of amplifier performance requirements. This done by successive elimination of variables from the corresponding system of nonlinear inequalities (twice as many inequalities for bilateral limits as for unilateral limits) pertaining to the real parts of the two immitances and to amplifier characteristics, whereupon that range of allowable immitances is approximated with physically realizable immitance operator functions. The second network is synthesized first, the first network being then analogously synthesized to match the first one. The procedure was applied to correction of a low-noise superwideband 0.001-3.0 GHz amplifier stage on a KT 3115 transistor for a power gain not lower than 10 dB with smaller than 1 dB variation over that frequency range. Figures 4; references 12: 10 Russian, 2 Western (1 in Russian translation).

UDC 534.852

Interference Immunity of Channels for Direct Digital Magnetic Recording with Two-Level or Multilevel Signal

18600019a Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 8 (manuscript received after completion
7 Sep 87) pp 7-10

[Article by S. I. Alyabyev]

[Abstract] Direct digital magnetic recording and playback are analyzed for immunity to intersymbol interference of channels which satisfy the Nyquist stability criterion, assuming no saturation and considering that the interference immunity of a channel depends on the number of signal levels as well as on the degree to which its transmission characteristic has been corrected. The signal-to-noise ratio is calculated accordingly, for two-level and n-level recording signals. An evaluation of numerical results indicates that nonredundant four-level encoding is the optimum tradeoff. Figures 2; references 2: 1 Russian, 1 Western (in translation).

UDC 621.391.822:621.376.9

Minimizing Effect of Flicker Noise During Synchronous Demodulation of Digital Signals

18600019d Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 88 (manuscript received 30 Oct 87) pp 52-54

[Article by V. Yu. Loskutov]

[Abstract] Synchronous demodulation of digital signals is considered, specifically conversion of a radio signal with digital modulation into a square wave video signal, under conditions of thermal and flicker noise. Minimizing the effect of flicker noise by limiting the signal spectrum on the low-frequency side and then processing the signal with a filter matched to signal and white noise is more expedient, because of the simpler structure of such a filter, than by processing the entire signal with a filter matched to signal and spectrally nonuniform noise. With the lower cutoff frequency selected optimally for maximum signal-to-noise ratio at a given upper frequency limit of flicker noise, the signal-to-noise ratio is shown to be almost as high after simple spectrum limiting as after exactly matched filtration. Figures 2; references 4: Russian.

UDC 621.372.62

Operation of Several Transmitters with One Common Antenna in Not Overlapping Frequency Bands

18600019f Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 88 (manuscript received after completion
4 Dec 87) pp 76-78

[Article by O. L. Zamulin]

[Abstract] A common antenna for n transmitters operating in not overlapping different frequency bands and feeding it through a frequency separator with maximum

intermodulation suppression is considered, wideband matching of such an antenna being limited by the frequency separator. The latter is assumed to be a nondissipative reciprocal $2(n+1)$ -pole network, its scattering matrix being normalized to its actual impedance load for the purpose of design and performance analysis. Wideband antenna matching is restored by insertion of an n-pole network between frequency separator and antenna, the determining factor being the sum of all transmitter banks and not how the frequency separator splits the antenna frequency range. An interesting concept is combination of a cyclic frequency separator and an n-band matching network. Figures 3; references 4: 2 Russian, 2 Western (1 in Russian translation).

UDC 621.39

Trends in Development of Electrical Communications, Part 1

18600020a Moscow *ELEKTROSVYAZ* in Russian
No 6, Jun 88 pp 1-11

[Article by G. G. Kudryavtsev and L. Ye. Varakin]

[Abstract] Inasmuch as the International Telecom-87 Exhibition and Forum-87 Conference can be regarded as trend indicators, major developments in electrical communications worldwide are both service and technology oriented. Telephone service has already reached a high technical level and is already broadly available everywhere, except in some Asian, African, and Latin American countries, so that only a relatively low expansion and development rate is to be expected in this area. In newer communication and data transmission modes such as Telex, telefax, teletext, videotext, and electronic mail, however, expansion and development may continue at the average annual 20 percent rate. A most important recent development with a key role to play in communications is the concept of an Integrated-Service Digital Network utilizing modern technologies such as very large-scale circuit integration, liquid-crystal displays, and fiber-optic transmission lines. High cost is the main factor limiting the availability of such networks to customers, but all electronic automatic telephone switching systems exhibited at the Telecom-87 (Alcatel-I.T.T. System 12, Siemens EWSD, Plessey System X, Fujitsu Fetex-150, NEC NEAX-61, A.T. & T. ESS-5 PRX) are adaptable to integrated-service digital networking. Use of fiber optics will promote developments in closed-circuit communications networks, with ports for access to a public communications network provided in a ring structure. Figures 12; tables 1; references 28: Western.

UDC 621.396.946.2.037.372

Interference in Digital Satellite Communication Systems

18600020b Moscow *ELEKTROSVYAZ* in Russian
No 6, Jun 88 (manuscript received 20 Jan 87) pp 31-36

[Article by V. M. Dorofeyev, Ye. A. Zlotnikova, and M. L. Payanskaya]

[Abstract] Interference in a digital satellite communication system is analyzed, the three major sources of

interference being: 1) other digital satellite communication systems transmitting two-position or four-position phase-shift keyed signals at rates of 32-120 Mbit/s, 2) analog satellite communication systems transmitting frequency-modulated telephone or television signals with high modulation index and frame-frequency or line frequency dispersion, 3) radio relay lines transmitting frequency-modulated signals with low modulation index. The effect of a harmonic interference signal and then that of an FM signal is estimated in terms of reception error probability, the upper bound for which is calculated by the Chernov method compared to that corresponding to inherent noise in the absence of interference. A special case are FM signals with frequency division of channels. Necessary corrections to the ICCR Standard 523 maximum permissible interference level at the demodulator input are made, on the basis of this analysis, for each kind of interference. Figures 10; references 6: 2 Russian, 1 Western 3 CCIR (Dudrovik/YUGOSLAVIA).

UDC 621.391.278

Ensuring Interference Immunity of Data Transmission Systems Operating with Composite Signals

18600020c Moscow ELEKTROSVYAZ in Russian
No 6, Jun 88 (manuscript received 5 Jan 87) pp 37-40

[Article by N. I. Smirnov and A. A. Kubitskiy]

[Abstract] A quick-response adaptive interference compensator is considered for maximizing the interference immunity of asynchronous multiaddress data transmission systems operating with a composite signal of multicriterially selected form under conditions where the interference may be much stronger than the useful signal, use of an adaptive compensator being preferable to adaptive signal processing by an appropriately oriented receiver antenna or to frequency-code division of subscribers' channels. Such a compensator is synthesized on the basis of automatic phase control for minimum mean-square error as the optimality criterion, its structure including a voltage-controlled oscillator as well as a phase detector and a synchronous amplitude detector for processing a weak useful signal and a strong harmonic interference signal with variable amplitude. The efficiency of such a compensator is estimated analytically first and then numerically for several values of two key parameters: time constant of automatic phase control times initial frequency mismatch and time constant of automatic phase control times interference frequency deviation. Figures 4; references 8: 7 Russian, 1 Western.

UDC 621.391.15

Ultrahigh-Precision Codecs and Codems of Multipositional Signals

18600020d Moscow ELEKTROSVYAZ in Russian
No 6, Jun 88 (manuscript received 23 Feb 87) pp 41-44

[Article by V. L. Banket, A. Ye. Doshchekhin, V. A. Goloshchapov, A. I. Lyakhov, A. M. Melnik, and A. V. Salabay]

[Abstract] Ultrahigh-precision codecs and codems for digital satellite communication channels with multiposi-

tional phase-shift keying were tested at 0.5 Mbit/s, the purpose being to evaluate the performance of the Viterbi maximum-likelihood algorithm including dependence of its energy efficiency on the specific coding speed R over the 1/8-4/5 range and to determine the feasibility of raising the specific speed or the energy efficiency without significantly lowering the other by appropriately matching the ensemble of phase-shift-keyed signals to the code. An energy efficiency of 4 dB and 5 dB was found to be attainable at a coding speed of $\frac{1}{4}$ and $\frac{1}{2}$ respectively in a codec with 4-position phase-shift keying. Two codems were then tested: a PhK-8-UHPC using the Gray code for most efficient and simple matching of the ensemble of 8-position phase-shift-keyed signals and the ultrahigh-precision code with $\frac{3}{4}$ specific speed to binary codes and a CAM-16-UHPC for cascaded codes with internal ensemble of 16-position phase-shift keyed signals. The results do not differ by more than 0.3 dB from the results of computer simulation with 32-level quantization of signals and with either the asymptotic energy gain or the upper bound for the error probability serving as the measure of energy efficiency, some additional energy loss being caused by intersymbol interference in the uncoded channel. Figures 6; references 11: Russian.

UDC 621.391.25

Optimization of Modem Filters for Satellite Communication System with Multistation Access and Time Division of Channels

18600020e Moscow ELEKTROSVYAZ in Russian
No 6, Jun 88 (manuscript received 16 Jul 87) pp 51-53

[Article by P. V. Ivashchenko and Yu. V. Lobodzinskiy]

[Abstract] The function of modem filters on the transmitter side and on the receiver side of multistation-access satellite communication systems with frequency division of trunks and time division of channels in each trunk, each transmitter channel containing two nonlinear components behind the modulator: a filter followed by an amplifier. The filter before the demodulator in each receiver channel must attenuate noise and interference from neighboring channels or from channels in other trunks as well as intersymbol interference, the latter interference becoming stronger as the selectivity of the filter on the transmitter side is increased and the nonlinearity of the amplifier behind it becomes more perceptible. Optimization of filters on both transmitter and receiver sides is considered, the energy efficiency of the system at a given level of interference immunity depending most on the characteristics of those on the receiver side. Simultaneous optimization of filters on both sides for minimum energy loss, with maximally flat group time delay, is not mathematically feasible and, therefore, suboptimum Butterworth filters are selected in preference to standard modem filters. The problem of optimum synthesis is solved by the method of nonlinear

programming, the filter for a receiver channel being optimized first and then the filter for a transmitter channel. Figures 5; references 5: 2 Russian, 3 Western.

UDC 621.372.9

Signal Converter with 14.4 Kbit/s Speed

18600020f Moscow ELEKTROSVYAZ in Russian
No 6, Jun 88 (manuscript received 16 Jan 87) pp 54-56

[Article by L. N. Afanasyev, V. P. Klimin, V. F. Kotlov, N. N. Olshevskiy, G. B. Seleznev, S. L. Shutov, L. N. Doroshkevich, and B. V. Sultanov]

[Abstract] A digital modem was built and tested for operation at a speed of 14.4 kbit/s in audio-frequency channels with single-sideband amplitude-shift and phase-shift keying where phase jitter has been either eliminated or at least reduced to a minimum. The transmitter consists of a data source, a scrambler, an encoder, a digital low-pass filter, a modulator with a source of reference oscillation, and a digital-to-analog converter with a low-pass filter. The receiver consists of an automatic level control with a regulator, an analog-to-digital converter with a clock synchronizer, a demodulator with a carrier synchronizer, a linear harmonic corrector, a resolver, a decoder, and an unscrambler. The algorithm of 8-position amplitude-shift (-A-5/7A, -3/7A, -1/7A, 1/7A, 3/7A, 5/7A, A) and 2-position phase-shift (0, 180 deg) keying is contained in a 3-bit binary code. The signal-to-noise ratio was found to be 28-32 with an error probability of correspondingly 10^{-4} - $4 \cdot 10^{-6}$ during operation "on itself" and $3 \cdot 10^{-4}$ - $6 \cdot 10^{-6}$ during operation with only one transceiver segment. Figures 4; tables 2; references 6: 5 Russian, 1 Western.

Prospects of Developing Integrated-Service Digital Network

18600020g Moscow ELEKTROSVYAZ in Russian
No 6, Jun 88 pp 58-59

[Article by V. G. Lazarev]

[Abstract] The fifth All-Union seminar on control problems in communication centers and networks (Odessa, September 1987) dealt extensively with construction and operation of an Integrated-Service digital Network generally and a wideband one specifically. The seminar had been organized jointly by the Institute of Problems in Data Transmission (USSR Academy of Sciences) and the Odessa Institute of Electrical Communications Engineering imeni A. S. Popov, with participation of the Science Council on the Complex "Cybernetics" Problem (USSR Academy of Sciences) and the Central Board of the Scientific-Technical Radio Engineering and Electrical Communications Society imeni A. S. Popov. It was attended by 60 specialists, including many young ones under 30 years old, representing 30 academic institutions and governmental agencies from 10 cities (Moscow, Leningrad, Riga, Kaunas, Kiev, Vinnitsa, Odessa, Novosibirsk, Tashkent, Alma-Ata). After 6 lectures and 10 papers delivered on the subject, it was recognized that establishing an Integrated-Service Digital Network in the USSR will require coordination of basic research, expansion of educational facilities to provide upcoming specialists with the necessary theoretical background, and a better access to information published by international agencies such as the CCIR on developments in Western countries.

UDC 621.317.333.82.001.4

[Article by O. V. Tozoni, doctor of technical sciences]

Distortion of Switching Pulses During Testing of External Superhigh-Voltage Insulation

18600030b Moscow ELEKTRICHESTVO in Russian
No 7, Jul 88 (manuscript received 8 Jun 87) pp 12-18

[Article by E. M. Bazelyan and M. V. Burmistrov]

[Abstract] Testing of superhigh-voltage insulation such as air gaps by application of pulses passing from a switched generator through an inductive-capacitive transformer stage or several of them is analyzed for distortion of these pulses along their path in the process. Theoretical expressions for the parameters of voltage pulses subject to distortion are derived on the basis of appropriate simplified linear equivalent circuits and in the approximation of a constant discharge current. These expressions take into account ohmic voltage drops and two exponential transient voltage components corresponding to the two roots of the characteristic equation, also voltage recovery after stalling of the leader. A comparison with experimental data including oscillograms reveals that the discharge current distorts voltage pulses along their path sufficiently for reducing the electric strength of long air gaps below its theoretical estimates. Figures 6; references 5: 4 Russian, 1 Western.

UDC 621.3.001.2.001.4

Creation of Base of Scientific Knowledge for Computer-Aided Theoretical Study and Computer-Aided Design of Electrical Engineering Apparatus

18600030c Moscow ELEKTRICHESTVO in Russian
No 7, Jul 88 (manuscript received 27 Oct 87) pp 1-11

[Abstract] A new approach to computer-aided design of new electrical engineering apparatus and attendant computer-aided theoretical study of electromagnetic fields in such apparatus is proposed which advances the state of the art by construction of mathematical models more reliable and less obsolescent than existing ones, also by providing objective criteria not now available for evaluation of mathematical models. Mathematical models facilitating numerical solution of boundary-value problems for systems of field equations, usually partial differential ones, are considered. The method of secondary sources and the method of electrodynamic circuit theory as well as the method of an expert system are among those available for analytical and numerical transformations converting a theoretical model into a working mathematical one. A base of scientific knowledge is needed for this, a functional and structural examination of such a base indicating that any analytical expression should be resolvable into simple tabulated elementary or special functions. Almost all simple functions encountered in applied analysis satisfy generating equations of the Y'' equal to $F(x, Y, Y')$ form solvable by the Runge-Kutta numerical method for subsequent conversion into continuous $Y(x)$ arrays on the basis of truncated Taylor series. The eight macrooperations on elements of analytical expressions are: Construction of composite functions from simple ones, construction of inverse functions, addition, multiplication, division, raising to a power, integration, and interpolation of composite functions. Not more than 60 simple programs are, accordingly, needed for calculations involving any of the entire set of analytical expressions. These programs, supplemented with programs facilitating numerical analysis and with service programs, can be stored on a magnetic disk for computer-aided design or theoretical study as required by the user. Figures 2; references 26: 21 Russian, 5 Western (all in Russian Translation).

UDC 621.317

Signal-to-Noise Ratio in Optical Fourier Processors with Light-Beam Intensity Modulation

18600019g Moscow *RADIOTEKHNIKA* in Russian
No 6, Jun 8 (manuscript received after completion
10 Dec 87) pp 79-82

[Article by A. F. Bukhenskiy and V. I. Yakovlev]

[Abstract] The ratio of maximum signal level to inherent noise level at the output of an optical Fourier processor with light-beam intensity modulation at the input is calculated, considering a processor which comprises an array of photosensitive charge-coupled devices and produces time integrals of nonsteady light intensity space distributions. The signal-to-noise ratio is shown to be of the order of 10 dB higher than that at the output of such a Fourier processor with amplitude modulation at the input and, therefore, to be more suitable for analysis of signals with large peak factors, the signal-to-noise ratio being generally improved by separate analysis of positive and negative parts of the signal. Figures 2; references 5: 3 Russian, 2 Western.

UDC 541.141.8

Effect of Shortwave UV Radiation on Thin Organic Films

18600088d Moscow *MIKROELEKTRONIKA*
in Russian Vol 17 No 6, Nov-Dec 88 pp 522-527

[Article by K. A. Valiev, L. V. Velikov, S. D. Dushenkov, and M. I. Ivanova]

[Abstract] This article considers the effect of shortwave UV radiation on organic films 50 nm or less in thickness. Photooxidation of a polymer surface under shortwave UV irradiation will alter the adhesive properties of the irradiated surface. This assumption underlies the experimental investigation carried out in this study. The experiments employed three types of gas-discharge shortwave UV sources: a hydrogen source, a krypton source, and a xenon source radiating in the 115-200 nm, 123.6 nm, and 147 nm ranges, respectively. It was initially discovered that upon making contact with the water some of the molecules in the upper polymer layer would enter the solution, i.e., after irradiation the polymer would become partially soluble in water. Overall the experiments revealed that the primary role in altering the surface properties of the thin organic films irradiated by shortwave UV radiation is played by the adhesion of oxygen from the environment to the molecules of these substances. This would be responsible for a partial solubility in water of a thin surface irradiated layer. These effects have important practical significance in the electronics industry where purity requirements on treated materials are continually increasing. One possible method of removing organic substances from the surface of various products involves shortwave UV irradiation of the surface in an oxygen-containing environment and washing of the irradiated samples in water. The effectiveness of this purification method is revealed by the fact that such treatment of monocrystalline silicon wafers that had already undergone the standard purification technology for microelectronics makes it possible to improve by a factor of 1.5 to 2 the adhesion of certain metallic films applied by vacuum deposition to the wafer surfaces.

UDC 537.622.3

Broadband Single-Cavity Maser for the 40-45 GHz Range with a Low Pumping Level
18600084a IZVESTIYA VYSSHIKH UCHEBNIKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 898-902

[Article by A. K. Blinov, V. V. Myshenko, S. A. Peskovskiy, and V. M. Shulga]

[Abstract] The possibility of expanding the transmission band of a one-cavity seven-millimeter maser by disorientation of the magnetic complexes of Fe(3+) ions in andalusite is demonstrated experimentally. In order to expand the transmission band of cavity maser it is necessary for the Q-factor of the EPR line to significantly exceed the magnetic Q-factor of the active medium. This condition is satisfied by an andalusite crystal doped by trivalent iron with perpendicular orientation of a constant magnetic field at frequencies above 25 GHz. The amplifier operates at frequencies near 40 GHz with the Q-factor of the EPR line equal to 280 with a magnetic Q-factor of the medium of the order of Q_m equals 10. The electrodynamic system of the maser is a two-mode cavity. The cavity is formed by a 1.9 by 1.8 by 0.36 cubic millimeter andalusite crystal in a compact waveguide (2.0 by 0.37 square millimeters in cross-section) bounded on one side by a tuning stub. With the crystal dimensions selected here the signal frequency of the cavity can be tuned by the short-circuiting stub within ten percent of the fundamental frequency (40-45 GHz). As a rule more than a single Y-circulator is required to provide stable operation of the maser. Independent non-mutual elements are normally used; regular waveguide isolators of Y-circulators in an isolator circuit can be used as such nonmutual elements. The additional circulators provide good isolation of the maser from the input and output devices. The maser developed using the devices described above provided a bandwidth of 25 MHz at a gain of 20 dB. The article stipulates that the most effective method of expanding the bandwidth is disorientation of the magnetic complexes. In this case the bandwidth of the maser is directly dependent on the disorientation angle of their magnetic axes. The amplitude-frequency responses of the maser are calculated for various gains and disorientation angles. Measured values of the inverted magnetic Q-factor, the Q-factor of the EPR line and the natural cavity Q-factor were employed as the initial parameters in the calculation. The experimental broadening of the maser bandwidth by disorientation of the magnetic complexes yielded a maser bandwidth of 100 MHz at a gain of 20 dB. The pump power in this case of less than 100 mW was sufficient to achieve a gain stability factor of less than 1 dB per dB. The article experimentally demonstrates the possibility of expanding the transmission band of single-cavity masers in the millimeter wavelength band to the level of traveling wave amplifiers.

UDC 523.164

Use of an Ideal Integrator in a Radiometer
18600084b IZVESTIYA VYSSHIKH UCHEBNIKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 903-906

[Article by G. G. Ayvazyan, A. M. Aslanyan, and A. G. Gulyan]

[Abstract] This article considers the issues of the actual utilization of an ideal integrator as an integrating device for a radiometer; this issue has been considered previously only as a mathematical model. The ideal integrator is implemented for the radiometer as an integrating sampling and storage device with the duration of the clock cycle determining the integration period. The device contains a voltage-controlled current source and three integrating capacitors, each of which is controlled by three switches with integration, storage and output operations carried out successively, as well as a reset operation. The output signal from the ideal integrator takes the form of the d.c. radiometer signal component which is calculated by integration carried out in the ideal integrator. Another feature of the ideal integrator in this design is that it not only detects but also amplifies the average output signal level in time unlike an RC-integrator in which the average input and output signals are equal. In modulation radiometers the ideal integrator is used both after and before the synchronous detector, and the unit carries out integration in each modulation cycle. The study suggests that the best combination of an ideal integrator and a digital processing system is a double integration ADC in which ideal integration is carried out during the conversion process.

UDC 621.396.677.494:621.396.674.3

Adaptive Angular Resolution of Uncorrelated Sources
18600084c IZVESTIYA VYSSHIKH UCHEBNIKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 941-946

[Article by A. B. Gershman, V. T. Yermolayev, and A. G. Flaksman]

[Abstract] The present study employs maximum likelihood and "thermal noise" methods to consider from a common viewpoint a new superresolution method. It is demonstrated that a characteristic of the type $l_{fh} n(l_{gv})$ equals $(s + m - nS) \exp -1$ for n is greater than 0 has a higher degree of angular resolution than the regular antenna beam scanning method involving an output power estimate. With an exact matrix M the resolution of the characteristics ηn monotonically increases with increasing n and asymptotically approaches the resolution of the eigenvector method as n approaches infinity; in the ideal case the resolution is infinitely great. It is also demonstrated that in order to resolve low power sources it is necessary to use characteristics ηn with large values of n and to increase the accuracy of determination of the matrix m . The calculations additionally suggest that an estimate of the spatial spectrum by the "thermal noise" method has a higher resolution than an estimate by the maximum likelihood method. Such characteristics have a variable error and, consequently, a variable degree of approximation to the spatial spectrum estimate using the eigenvector method. The general treatment of the maximum likelihood method, the "thermal noise" method and the more general method proposed in the study allows analysis of the spectral estimates ηn with different values of n as a result of a

uniform transformation that isolates the characteristic η with a varying degree of accuracy. It is determined from experimental analysis that in actual conditions of a finite averaging interval the resolution of the characteristics η diminishes compared to the case j equals infinity, although the trend towards increasing resolution with increasing power n is conserved. This fact supports the resistance of this resolution method to random error caused by the finite number of samples J . The method is also valid for nonequidistant arrays as well as for the case of another source field propagation model. In this case the control vector S must account for both the nonequidistant nature of the arrays and the propagation model.

UDC 537.874.6

E-Polarized Electromagnetic Wave Scattering by a Cylindrical Screen in the Presence of a Half-Plane
18600084d IZVESTIYA VYSSHIKH UCHEBNYKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 947-957

[Article by Z. T. Nazarchuk] [Abstract] This study employs integral equations to solve a plane problem of electromagnetic wave diffraction by an infinitely thin, ideally-conducting screen and half-plane in order to analyze a new electrodynamic structure consisting of a cylindrical screen of arbitrary profile and a half-plane. An algorithm is developed on this basis and its advantages include simplicity of calculation of the weights and nodes of the quadrature formulae. Its drawback is the need for numerical integration of the functions $G^E E'$. The theoretical construct is used to determine the field of a plane wave diffracted by a parabolic screen. The amplitude and phase calculation results are plotted in several figures for various antenna parameters. The approach proposed in this study makes it possible to effectively determine the diffraction field for a randomly configured (within the framework of the plane problem) cylindrical screen and half-plane. It is significant that when this method is used it is not necessary to carry out the cumbersome evaluation of integrals with oscillating functions represented in a semi-infinite interval.

UDC 534.832:62-532.8

Investigation of Active Narrowband Acoustic Field Suppression System With Search Tuning Algorithm
18600084e IZVESTIYA VYSSHIKH UCHEBNYKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 958-963

[Article by I. A. Korolev, A. A. Maltsev, and V. V. Cherepennikov]

[Abstract] This study reports results from an experimental investigation of the characteristics of an adaptive narrowband acoustic field suppression field system that employs a search tuning algorithm. The adaptive suppression system employs a single suppression radiator

and a single test meter. The necessary suppression radiator control signal was developed by means of time-variable weighted summation of the quadrature reference signal components; a signal direct from an oscillator exciting an "external" field radiator was used as this signal. An adaptive search algorithm with a harmonic search signal with a frequency of the order of 40 Hz was used to tune the weight coefficients. An experiment was carried out in order to test the function of the suppression system employing the search tuning algorithm with both a fixed and time-variable positioning of the suppression radiator and the test meter. The measurements were carried out at the resonant frequency of one of the longitudinal modes. Several graphs are provided and these suggest that the suppression system employing a search tuning algorithm accurately "tracks" the motion of the test meter, and the level of the initial field at its location diminishes by 25 to 30 dB. However, the degree of field suppression across the entire suppression range is clearly somewhat lower and is only 15-20 dB. The search tuning algorithm of the adaptive active suppression system proposed in this study makes it possible to achieve a somewhat lower degree of acoustic field suppression compared to a normal gradient algorithm (due to the additional field perturbation caused by the search signal) although it is a more universal method since it can operate with variation of the relative position of the suppression radiator and the test meter as well as with variable characteristics of the medium.

Numerical Modeling of Nonlinear Processes in DRG-Autodyne
18600084f IZVESTIYA VYSSHIKH UCHEBNYKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 974-983

[Article by G. P. Yermak, A. B. Lebedev, and K. A. Lukin]

[Abstract] This study develops an effective method for numerical modeling of a DRG-autodyne, which is a diffraction radiation generator activated by the natural coherent radiation reflected off of a test object; this method allows calculation of the autodyne characteristics when the working current slightly exceeds the standard level and near the bifurcation points of the system as well. This technique is used as the basis for carrying out theoretical investigations of a DRG-autodyne at near-starting current levels over a broad range of fundamental control parameters. Experimental measurements revealed that the autodyne gain reaches a maximum at near start-up current levels and that an increase in the gain from 0.1 to 6.0 will cause a three to four order of magnitude growth in the autodyne gain. A change in the natural Q-factor and number of diffraction grating periods has no significant influence on the maximum and minimum autodyne gains in the generation region. At the same time the size of the region changes and its boundaries are shifted. The GRD-autodyne is shown to have satisfactory sensitivity from recording the autodyne response in the power supply network. The concept of

the autodyne current response factor is introduced. A comparison of calculation to experimental data demonstrated a good correlation. A functional relation is also obtained that makes it possible to approximate the behavior of the autodyne gain with a variable velocity asynchronism. The expression obtained in this study when used in combination with the highly effective method also developed in this study has made it possible to draft an analytic relation based on several test measurements in both numerical and laboratory experiments for the autodyne gain and to calculate this gain at any point within the generation region.

UDC 621.382.2

Low-Frequency Fluctuations in the Microwave Admittance of Gunn Diodes

18600084f IZVESTIYA VYSSHIKH UCHEBNIKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 1001-1005

[Article by A. S. Karasev and V. I. Shevchenko]

[Abstract] This study describes a method for experimental investigation of the spectral densities and the correlation of fluctuations in the microwave conductance and admittance of active one-ports and results are given from an experimental investigation of admittance fluctuations for a Gunn diode operating in the three-centimeter wavelength band. The measurements were carried out on a test diode in parallel to a transmission line, and the amplitude and phase fluctuations of signals transmitted through and reflected off of the diode were measured followed by a calculation of the desired quantities. The test diodes operated in the three-centimeter wavelength band and were fabricated from n+-nb-n-structures with an active length of l equals 12 micrometers and a dopant concentration of 9 times 10^{14} cm^{-3} . The semiconductor crystal was mounted in a compact housing with a parasitic ceramic capacitance of 0.1 picofarad and an input inductance of 0.3 nano Henries. The resonant frequency of the housing was much greater than the operating frequency of 10 GHz. In the frequency test range at slightly over threshold the spectral fluctuation density has a weak frequency dependence, which makes it possible to assume that in this mode the admittance fluctuations are caused by ultrahigh frequency fluctuation processes, specifically intervalley noise with a maximum intensity in near-critical fields. There is in this case a strong correlation between the conductance and admittance. An increase in the bias voltage causes the fluctuation level to diminish and frequency-dependent spectral components appear. This can be attributed to the change in the electrical field distribution lengthwise along the diode. An increase in amplitude causes a substantial drop in the admittance fluctuations. This effect occurs at amplitudes substantially lower than the amplitudes corresponding to the normal operating conditions of the generator. Overall this study presents the

first experimental data on microwave admittance fluctuations in Gunn diodes. It reveals a strong dependence of fluctuations on the bias voltage and the microwave signal amplitude.

UDC 621.396

Determination of Range-Velocity Characteristics of Atmospheric Irregularities

18600084f IZVESTIYA VYSSHIKH UCHEBNIKH
ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31 No 8, Aug 88 pp 1009-1011

[Article by A. V. Moroz]

[Abstract] This study proposes a method of calculating the group delay time of echo signals and the Doppler frequency shift by a temporal implementation of a complete echo signal for application to diagnostics of irregular atmospheric formations; it is assumed in this analysis that the partial echo signals are not delay- or Doppler-frequency-resolved in the classical Rayleigh sense. The primary assumption underlying this analysis is that the probe signal envelope is Gaussian. The echo signal is assumed to pass through a processor which isolates its complex envelope. An expression is derived for the output signal that, upon further manipulation, produces the frequencies containing the desired frequencies HK. The frequencies actually present in the expression will remain unchanged (accurate to calculation error) with increasing approximation order, so the "false" frequencies whose number is p minus m will vary irregularly. This fact makes it possible to identify the true frequencies as well as to estimate the a priori unknown number of scattering elements m . In the general case this expression is overdefined. Its solution understood in the sense of the least squares method is obtained in order to illustrate the effectiveness of the proposed method, the signal implementation is numerically modeled and the group delay time of the echo signals and the Doppler frequency shift are recovered using the implementation. Tables are given providing the results from the recovery of the delay and Doppler frequency shift parameters. These data clearly reveal stable recovery of the parameters actually present in the signal implementation and an irregular nature of the variation in "false" parameters with varying p . Analogous results were obtained in calculations with other values of the variables. In fact, the effectiveness of the method discussed in this article for estimating the motion parameters of scatterers is determined by multiple factors, including the duration of the observation interval, the input realization sample, the additive noise level, possible deviation of the partial echo signal envelope from Gaussian form, the implementation algorithm, etc.

UDC 621.382.001.2

Optimization and Investigation of Superfast Cryoelectronic Counter

18600088a Moscow MIKROELEKTRONIKA
in Russian Vol 17 No 6, Nov-Dec 88 pp 483-489

[Article by V. V. Rakitin and V. A. Enkovich]

[Abstract] Mathematical modeling of the operation of a superfast cryoelectronic counter based on a 2-contact superconducting quantum interferometer is used to opti-

mize the primary operating parameters of the counter in order to obtain a maximum range of function and speed. The functional range is calculated based on the amplitudes of control signals. It is established that when lead-based Josephson junctions are employed with a critical current density of $10 \exp 4$ to $10 \exp 5$ amps per square centimeter, the counter speed is approximately 100 GHz and can be increased to 500 GHz by increasing critical current density to $10 \exp 4$ to $10 \exp 5$ amps per square centimeter. An integrated counter circuit is developed and investigated. Counter function over a broad frequency range of 0 to 100 GHz is demonstrated experimentally. The influence of interferometer parameters on the functional range of the counter and its speed is analyzed. The range of operation of the counter and its frequency responses are measured and a good agreement between experimental results and calculations is obtained.

UDC 621.382.8

Comparative Analysis of the Effectiveness of Ionization and Electrical "Latch-UP" Effect Simulation in Integrated Circuits

18600088b Moscow MIKROELEKTRONIKA
in Russian Vol 17 No 6, Nov-Dec 88 pp 490-495

[Article by Ye. R. Astvatsaturyan, V. V. Yelesin, and A. V. Ratkin]

[Abstract] This article considers the possibility of using the "dU versus dt effect" to experimentally investigate the "latch-up" effect in test specimens of CMOS integrated circuits. This effect is largely responsible for limiting the increase in the level of integration of one of the most promising VLSI chip technologies. The ionization and electrical methods of simulating the "latch-up" effect are compared in the range of excitation pulse durations where the drift component of the p-n junction of the pocket - substrate photocurrent predominates. This is valid in both the linear and quasi-linear regions of the excitation levels. The study derives analytical relations for the scaling factors in the linear and quasi-linear regions, making it possible to carry out an experimental investigation of the "latch-up" features of parasitic four-layer structures within the framework of the ionization and electrical methods. The experimental investigations of "latch-up" based on pulsed ionization of the structure are related to industrial fabrication complexities in laboratory or factory conditions and hence it is important to use the dU versus dt effect for these purposes. The article provides charts and graphs indicating the ranges where each of the methods provides adequate simulation.

UDC 621.382

Comparison of Submicron Schottky- Gate Field-Effect Transistor Calculations Employing Quasi-Hydrodynamic and Kinetic Models

18600088c Moscow MIKROELEKTRONIKA
in Russian Vol 17 No 6, Nov-Dec 88 pp 504-510

[Article by V. A. Nikolayeva, V. D. Pishchalko, V. I. Ryzhiy, G. Yu. Khrenov, B. I. Chetverushkin]

[Abstract] This article is devoted to a two-temperature quasi-hydrodynamic model and a comparison of this model to a kinetic model to investigate nonequilibrium

electron processes in submicron gallium arsenide Schottky-gate field-effect transistors based on a calculation of the potential, electron concentrations and their effective temperatures in the submicron FET channel. The simulation assumes that the Schottky-gate FET is based on an epitaxial n-layer of thickness d with metallic source, drain, and gate contacts. A rectangular calculation range is selected since the upper bound corresponds to the n-layer surface onto which the contacts are applied, while the lower bound corresponds to the n-layer-substrate interface. Several graphs plot the distribution of electron concentration, the population ratio of the lateral and central valleys, the drift velocity, and the average electron temperature of the valleys along the Schottky-gate FET channel calculated within the framework of the quasi-hydrodynamic and kinetic models. These figures clearly suggest that the concentration distribution, population ratio of the values, and the drift velocity obtained by the various models are similar not only in magnitude but also in characteristic features of the distributions. This indicates an adequate description of the intervalley electron transitions within the framework of the proposed two-temperature quasi-hydrodynamic model.

UDC 621.382

Radiation-Stimulated Generation of Thermally Stable Electrically-Active Defects in SiO₂

18600088e Moscow MIKROELEKTRONIKA
in Russian Vol 17 No 6, Nov-Dec 88 pp 548-503

[Article by S. N. Koszlov, Yu. V. Shcheblykin, and Yu. N. Kasumov]

[Abstract] This study investigates defect formation in an SiO₂ layer under irradiation by low-energy electrons and soft X-rays over a broad dosage range of $10 \exp 4$ to 5×10^9 rad. MIS insulated gate transistor structures fabricated from KDB-20 silicon with a (100) surface orientation were investigated. The SiO₂ films 0.12 micrometers in thickness were obtained by high-temperature oxidation in silicon in dry oxygen. The gate was fabricated from aluminum. A voltage of 10 millivolts was applied between the transistor source and drain. With grounded contacts the structures were irradiated by W_e equals 11.5 keV electrons (beam current density from 1 to 15 microamps per centimeter $\exp \pm 2$) and χ rays of energy W_r equals 6.3 keV. Based on the experimental results and general modern concepts of radiation solid state physics it is possible to conclude that the nature of the neutral traps is related to the local reconstruction of the valence Si-O-bonds due to radiative action. The deformation of the Si-O-bonds causes their polarization and potential wells are therefore formed near the distorted bonds for the electrons, i.e., electron traps are formed. The radiation-stimulated rearrangement of the valence bonds can therefore be implemented by a variety of techniques. The point defects formed in the initial irradiation stage are mobile in SiO₂ due to the mechanical stress gradient existing in the

oxide. Defect complexes may arise due to their migration. A radiation excitation threshold is characteristic of radiation defect cluster formation processes.

Cylindrical Arrays for LSIC Optical Interconnections

18600088f Moscow MIKROELEKTRONIKA in Russian
Vol 17 No 6, Nov-Dec 88 pp 561-563

[G. G. Golenko, I. N. Dyuzhikov, M. I. Yelinson, and N. V. Melnikova]

[Abstract] This article discusses a promising method of producing important component nodes of optical interconnections: grid optics and systems based on grid optics. A simple optical system with a spherical lens grid

can be used to fabricate a regular array of parallel optical channels with an interchannel distance equal to or less than the grid pitch. The article also reports new possibilities for using a parallel grid with cylindrical lenses. When such a grid is illuminated by a parallel beam and band system with an interband distance equal to the grid pitch is formed in its focal plane. A single band can be used to eliminate a strip of modulators or photodetectors. An advantage of optical interconnections based on cylindrical grids is that they are insensitive to tuning along the grid axis and one drawback is the losses in the gaps between the modulators in the strip. Additional advantages are achieved by using several grids. A system employing two successive grids is effective in schemes with a low linear optical interconnection density.

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